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## Notes:

1. Untranslatable words are replaced with asterisks (\*).\*\*
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Translated: 18:07:54 JST 02/23/2005

Dictionary: Last updated 10/12/2004 / Priority:

JP 2509293 B2

02

## CLAIMS

## (57) [Claim(s)]

[Claim 1] Chemical composition is C at weight % : 2.8 to 3.5%, Si : 1.5 to 2.5%, Mn: 0.5 to 1.0%, P : 0.1% or less, S : 0.08% or less, nickel: 3.5-4.5% (except for 4.5%), Cr : 3.5 to 5.0% (except for 5.0%), Mo: The hot run table roller characterized by being formed in a remainder real target by Fe, and forming the activity layer 0.3 to 1.0% by the graphite crystallization chromium cast iron material which consists of a base where the organization made carbide, a graphite, and bainite the subject.

[Claim 2] Chemical composition is C at weight % : 2.8 to 3.5%, Si : 1.5 to 2.5%, Mn: 0.5 to 1.0%, P : 0.1% or less, S : 0.08% or less, nickel: 3.5-4.5% (except for 4.5%), Cr : 3.5 to 5.0% (except for 5.0%), Mo: The pinch roll for coilers characterized by being formed in a remainder real target by Fe, and forming the activity layer 0.3 to 1.0% by the graphite crystallization chromium cast iron material which consists of a base where the organization made carbide, a graphite, and bainite the subject.

## DETAILED DESCRIPTION

## [Detailed Description of the Invention]

## (Field of the Invention)

This invention relates to a hot run table roller and the pinch roll for coilers excellent in abrasion resistance and printing-proof nature.

## (PRIOR ART)

By a general manufacturing process, in the common-name hot run table which has a length of 100-150m, controlled cooling according to expected quality is performed, and the strip by which hot finish rolling was carried out with the hot strip mill is rolled round in the shape of a coil with a reel 31, as shown in Fig. 5. As for 32, in this drawing, the top pinch roll for coilers and 34 are bottom product pinch rolls the roll for finish rolling, and 33. The higher hardness welding layer is usually formed in the roll body as an activity layer the pinch roll 33 for coilers, and 34 by Co base Stellite system padding material, the Fe base Cr-Mo system padding material, etc. Said hot run table arranges the roller 35 300-350mm in diameter on a 350-500mm interval, and is constituted, and the roller total number amounts also to 250-350.

Said controlled cooling is performed by cooling zone B prepared in the halfway section of the hot run table. Cooling zone B is equipped with many cooling headers 36, it directs in a strip, and cooling water 37 is spouted. For this reason, the water screen is formed in a roller surface in cooling zone B.

The semi wet zones A and C are formed before and after said cooling zone B. In the semi wet zones A and C, in order to be stabilized and to convey a strip, supply of cooling water is not performed.

Usually, in order to be stabilized and to convey a strip, a hot run table roller is rotated so that it may become a peripheral speed quicker 8 to 20% than a bearer rate. Since the bearer rate of a strip is 800 - 1200 m/min intensity, it has usually caused the relative skid with intense strip and roller surface. Moreover, because of the heat of existence of the cooling water for controlled cooling, and a strip, the roller surface has been corrosion atmosphere and progress of wear is remarkable. For this reason, the abrasion resistance which was excellent as roller construction material is required.

As a roller which meets such a demand, the high-Cr-steel roller with which surface hardness was set to Hs 65-75 is known. When the high-Cr-steel roller beyond Cr8wt% was used for the cooling zone, abrasion loss was actually every year, 2-3mm, and good results in the diameter decrement.

However, there is a fault that a high-Cr-steel roller has bad thermal conductivity, and printing-proof nature cannot be expected. If printing occurs, a printing crack will be imprinted by the strip surface and product quality will once be reduced. For this reason, the actual condition is that the high-Cr-steel roller is used only in the cooling zone for which printing-proof nature is not needed since the water screen is formed in a roller surface.

Therefore, in the semi wet zone where the water screen is not formed in a roller surface, the high-Cr-steel roller excellent in abrasion resistance cannot be used, but, generally the ductile-cast-iron roller which printing does not generate easily, and the 3%nickel cast iron roller are used. However, since these rollers were inferior to abrasion resistance, wear was remarkable, and reached also in about tenmm per year in the roller diameter decrement, the replacement expense of the roller increased remarkably, and they had become a problem.

(Object of the Invention)

To such a problem, as indicated in the JP,61-557,A number, the roller for semi wet zones which formed the conveyance activity layer by the graphite crystallization high-chrome-cast-iron material which combined abrasio: resistance and printing-proof nature was developed.

However, although Cr carbide which could not say that it was equipped with printing-proof nature sufficient in construction material since Cr contains said graphite crystallization high-chrome-cast-iron material so much with 5 to 10%, and was generated all over the base is higher hardness in M7C3 mold It is a thin form from the surface of the activity layer toward the interior, and the resistance over the shearing force which acts on the surface of an activity layer is not enough, it is easy to produce wear in the periphery of a graphite grain to apply and according to omission, and the wear-resistant improvement is demanded. Furthermore, in order to make expensive nickel contain so much with 4.5 to 10%, there was a problem of being inferior to profitability.

On the other hand, since the weld bead at the time of build-up welding exposed the pinch roll for coilers in an activity layer and the abrasion resistance of this portion was inferior, it was easy to produce dry rough skin and seizure, and there was a problem that a bead pattern was imprinted by rolled plates and sheets of steel.

It aims at offering the hot run table roller and the pinch roll for coilers where this invention was made in view of the trouble, and had the printing-proof nature and abrasion resistance which were excellent as an activity layer and which were excellent also in profitability.

(The means for solving a technical problem)

[ the hot run table roller and the pinch roll for coilers of this invention which were made in order to attain the above-mentioned object ] :2.8-3.5%, Si:1.5-2.5%, Mn : C 0.5 to 1.0%, P : 0.1% or less, S : 0.08% or less, nickel : 3.5 to 4.5% (except for 4.5%), Cr: 3.5-5.0% (except for 5.0%), Mo: Consider as the composition of invention that it is formed in a remainder real target by Fe, and the activity layer is formed 0.3 to 1.0% by the graphite crystallization chromium cast iron material which consists of a base where the organization made Cr carbide, a graphite, and bainite the subject.

(OPERATION)

The conveyance activity layer of this invention roller Si:1.5-2.5%, nickel:3.5-4.5% (except for 4.5%), Cr: Since it formed by the chromium cast iron material of the specific presentation which has 3.5 to 5.0% (except for 5.0%), a graphite crystallizes with Cr carbide of higher hardness, and crystallization of a cementite, and it becomes what had abrasion resistance and printing-proof nature. A cementite does not have directivity in a form like Cr carbide since particle size is also large, it applies, and the resistance over omission wear is good and wear-resistant improvement is achieved by coexistence of both carbide.

Moreover, since the base organization was constituted from a tough organization which made bainite the subject, the carbide of a graphite grain periphery can chip, wear by omission can be prevented further, and abrasion resistance can be improved.

Furthermore, as a result of toughening the conveyance activity layer itself in the case of a hot run table roller, it becomes unnecessary to form and composite-ize the inner layer which becomes the inner surface of a conveyance activity layer from tough material, and the productivity of a roller can be raised.

(EXAMPLE)

While explaining hereafter the Reason for component definition of the graphite crystallization chromium cast iron material which forms this invention roller and the activity layer of a roll, reference is made about application in an activity layer. All component units are [ the following and ] weight %.

C:2.8 to 3.5% It becomes a graphite with the graphitizer of Si and nickel, and it crystallizes while C combines with Cr and Fe, forms higher hardness Cr carbide and a cementite and contributes to wear-resistant improvement. At less than 2.8%, formation of Cr carbide and crystallization of a graphite decrease, and abrasion resistance and printing-proof nature deteriorate. On the other hand, if 3.5% is exceeded, in the Cr content in this invention, crystallization of a graphite will become excessive and abrasion resistance will be degraded.

Si: 1.5 to 2.5% Si is an element required in order to make a graphite crystallize with nickel. With the Ni content of this invention, at less than 1.5%, if a graphite is hardly crystallized but 2.5% is exceeded on the other hand, crystallization of a graphite will become excessive and abrasion resistance and toughness will fall.

Mn: 0.5 to 1.0% Mn is needed on a manufacturing process for deoxidation and desulfurization. At less than 0.5%, the above-mentioned operations run short, and if 1.0% is exceeded on the other hand, the toughness of a base organization will fall.

P: 0.1% or less The more there is little P, it is desirable and, the more it may be 0.1% or less from the point which prevents embrittlement.

S: 0.08% or less The more there is, it is desirable and, the more S may be 0.08% or less, in order to make construction material weak like P. [ little ]

nickel: 3.5 to 4.5% (except for 4.5%)

nickel is contained in order to make a graphite crystallize, while making a base organization detailed and raising toughness. Effect sufficient at less than 3.5% is not acquired, but on the other hand, at 4.5% or more, retained austenite is increased and printing-proof nature is checked. Moreover, it becomes the factor of a cost overrun.

Cr: 3.5 to 5.0% (except for 5.0%)

Cr combines with C, forms about 1350-Hv higher hardness Cr carbide, and contributes to wear-resistant improvement most. Abrasion resistance there is little Cr carbide and it is sufficient at less than 3.5% is not securable. On the other hand, at 5.0% or more, most carbide to generate turns into only Cr carbide, the generative of a cementite of it is almost lost, crystallization of a graphite is also controlled, and printing-proof nature and abrasion resistance fall.

Mo: 0.3 to 1.0% Mo is made to contain like nickel for a base organization consolidation. At less than 0.3%, since retained austenite will be stabilized if the effect does not exist and 1.0% is exceeded on the other hand, it is hardly desirable.

As for the graphite crystallization chromium cast iron material of this invention, the remainder besides the above mentioned alloy content consists of Fe and an impurity mixed unescapable.

The above-mentioned chromium cast iron material becomes what was as-cast state, and the graphite crystallize with higher hardness Cr carbide and a cementite crystallized all over retained austenite, the pearlite, and the base formed with martensite in part. By coexistence of the carbide with which a graphite differs from a form, printing-proof nature can be secured and wear-resistant improvement can be aimed at.

In this invention, toughening of the base was attained with heat treatment by having considered most of said base most of [ all or ] as the bainite organization, and by this, it was made hard to cover the carbide of a graphite grain periphery further and to fall, and has contributed to wear-resistant improvement.

After said heat treatment carries out heating maintenance of the casting material at austenitizing temperature, it is quenched at 400-600 degrees C, 5-15Hr maintenance is carried out at this temperature, and the process which is made to carry out isothermal transformation of most most [ all or ] to bainite, and anneals them after that is taken.

Since the base is formed in the subject in tough bainite, the graphite crystallization chromium cast iron material of this invention becomes what \*\*\*\*(ed) toughness also as the whole cast iron material. therefore, [ material / can use this invention cast iron material as an activity layer slack outer layer material of a hot run table roller or the pinch roll for coilers, and also / in the case of the roller which does not require big load ] It is usable also as casting material of a simple substance roller (the great portion of roller thickness functions as a conveyance activity layer in this case.).

When using this invention cast iron material as an outer layer material of a composite roller or a compound roll, a thinner layer material, cast iron material with the toughness of semi-steel, ductile cast iron, etc. is usually used suitably.

Although the hot run table roller and pinch roll of this invention are offered as a composite roller, or a roll or a simple substance roller, it is usually that the cylindrical shape drum section in which it has an activity layer in [ any ] a form is cast by a spun casting method.

In the base of an activity layer, in order to make bainite into a subject, heat treatment as stated above is performed, after the spun casting of a drum section machines while assembling a shank to drum section ends after that, and let it be a predetermined product roller. In addition, with the roller said to this invention, the cylindrical body itself which constitutes a drum section is included.

Next, the concrete example of the hot run table roller of this invention is explained.

First, the manufacture example of the simple substance roller of the drum section outer diameter of 320mm, the drum section bore of 195mm, and 1730mm of drum length is explained.

(1) the spun casting which rotates the roller material molten metal concerning this invention of the 1st table of the following on a casting machine — public funds — it cast at 1380 degrees C in the mold, and cooled slowly to ordinary temperature.

	C	Si	Mn	P	S	Ni	Cr	Mo
実施例 1	3.11	1.96	0.68	0.020	0.007	4.15	4.13	0.35

注 単位重量%, 残部実質的にFe

(2) After drum section casting, after having quenched at 500 degrees C, having held at 500 degrees C for 10 hours, after carrying out heating maintenance with a heat treating furnace at austenitizing temperature (850 degrees C), and making a base metamorphose into bainite, it cooled slowly.

(3) The result of having carried out microscope observation of the metal texture of a drum section is shown in Fig. 1 and Fig. 2.

While carbide crystallizes so much on a bainite base more detailed than Fig. 1, the state where the graphite has crystallized is known. Moreover, the state where a graphite covers the whole region in an organization and distributed crystallization is carried out from Fig. 2 is \*\*\*\*(ed). In addition, Fig. 2 grinds a sample and is not corroding it in a request.

(4) After machining a drum section, the assembly and the product roller were obtained for the shank to the ends. It was checked by the hot run table in this roller that abrasion resistance is superior to the high-Cr-steel roller which abrasion loss is 0.7-1.0mm in a diameter decrement, and is made good [ the conventional abrasion resistance ] when an online test is done for one year, a nest and. Moreover, there was no generating of printing in a semi wet zone.

Next, the manufacture example of the composite roller of the drum section outer diameter of 330mm, the drum section bore of 170mm, and 1700mm of drum length is explained.

(1) the spun casting which rotates the outer layer material molten metal of the chemical composition shown in the 2nd table on a casting machine -- public funds -- thick in a mold -- a 50mm minute (cast weight of 680kg) -- it cast. Casting temperature was made also into the example and the conventional example with 1380 degrees C. In addition, the conventional example is the graphite crystallization high-chrome-cast-iron material of disclosure in a JP,61-557,A number.

第 2 表 溶 湯 化 学 組 成

		C	Si	Mn	P	S	Ni	Cr	Mo	Mg
実施例11	外層	3.08	1.84	0.72	0.021	0.007	4.21	4.20	0.37	—
	内層	3.53	2.14	0.35	0.047	0.007	0.72	0.24	0.08	0.076
従来例	外層	2.93	2.89	0.93	0.051	0.010	7.32	8.56	0.68	—
	内層	3.45	2.48	0.49	0.040	0.013	0.73	0.15	0.08	0.066

注 単位重量% 残部実質的にFe

(2) When an outer layer inner surface solidified mostly (after [ of a cast start ] 10 minutes), it was thick and the inner layer material (ductile cast iron) molten metal shown in the 2nd table was cast to the 30mm (cast weight of 300kg) part outer layer inner surface.

(3) The outer layer and the inner layer were thoroughly solidified 25 minutes after the cast start of an outer layer. Then, after stopping the revolution, cooling slowly to ordinary temperature and carrying out heating maintenance of the roller drum section from mold at drawing and austenitizing temperature (850 degrees C), it quenched at 500 degrees C and furnace cooling was carried out after 10-hour maintenance at this temperature.

(4) After machining a drum section peripheral face, the ultrasonic crack inspect of this drum section was carried out. As a result, the example 11 and the conventional example of joining of an outer layer and a inner layer were good. in addition, it is based on the inner layer molten metal of an outer layer -- it was melted and \*\* was 6-8mm.

Moreover, the result of having investigated the inner layer presentation after casting is shown in the 3rd table. In addition, since it was almost the same as that of a molten metal presentation, the written abbreviation of the outer layer presentation was carried out.

第 3 表 製品化学組成

		C	Si	Mn	P	S	Ni	Cr	Mo	Mg
実施例11	内層	3.51	2.14	0.33	0.049	0.007	1.98	0.92	0.08	0.074
従来例	内層	3.44	2.50	0.52	0.043	0.012	2.68	0.98	0.09	0.062

注 単位重量% 残部実質的にFe

(5) From the drum section obtained as mentioned above, the test piece was extracted and the mechanical property of an outer layer, printing-proof nature, and abrasion resistance were investigated.

\*\* The result of having investigated the mechanical property is shown in the 4th table.

第 4 表

	引張強度(kg/mm <sup>2</sup> )	伸び(%)	硬度(Hs)
実施例11	72	1.53	71
従来例	68	0.89	79

Although this invention example is inferior to the 5th table in a degree of hardness a little as compared with the conventional example, intensity and elongation are excellent and it is known that toughness is good.

\*\* The FABIRI examination investigated printing-proof nature.

(i) A FUABIRI examination fixes the end of a test pin 11 to a rotating machine 12 by the shear pin 13, as shown in Fig. 3. A test pin 11 is rotated pinching the other end by a pair of V blocks 14, and 14 under the fixed load P, and the torque which the revolution took investigates the existence of printing, and intensity.

(ii) The test condition of the FUABIRI examination was as follows.

Test pin size .... phi6.5x40IV block size .... phi12 test-pin rotational frequency — 300rpm (0.1m/(sec))

Load load P ..... 35kg test atmosphere ..... although the standup of the remarkable torque which indicates printing states to be also an example 11 and the conventional example was not seen as a result of the non-lubrication (iii) FUABIRI examination As for the maximum torque which the revolution took, 45kg.cm and the conventional example of an example 11 are 34kg.cm, and, as for an example, it is known that printing-proof nature is better than the conventional example.

\*\* Abrasion resistance did the roller abrasion test in the following way, and evaluated it by measuring a diameter decrement.

(i) Examination point As shown in Fig. 4, the steel rollers (50mm in width) 22 heated by 500 degrees C were pressed against the examination roller 21 extracted from the roller of the example and the conventional example at 1500kg, the examination roller 21 was rotated, and the diameter decrement after a predetermined revolution of the examination roller 21 was investigated.

(ii) result The diameter decrement per 106 revolutions of an examination roller was as follows.

The 11....0.18% of example conventional example .... 0.33% (iii) assessment As for the example 11, compared with the conventional example, it was checked that about 45% of wear-resistant improvement had been achieved. Moreover, the concrete example of the top pinch compound roll for down coilers of the drum section outer diameter of 900mm, the drum section bore of 700mm, and 1800mm of drum length is explained.

(1) the spun casting which rotates the roll outer layer molten metal concerning this invention of the 5th table of the following on a casting machine — public funds — after it cast at 1,380 degrees C in the mold and the after-casting molten metal inner surface solidified, the inner layer molten metal shown with this table was cast, and it cooled slowly to ordinary temperature.

第 5 表

		C	Si	Mn	P	S	Ni	Cr	Mo	Mg
実施例21	外層	3.20	1.87	0.70	0.015	0.007	3.97	4.21	0.41	—
	内層	3.58	1.82	0.18	0.050	0.006	0.56	0.08	0.10	0.065

(2) After drum section casting, after having quenched at 500 degrees C, having held at 500 degrees C for 10 hours, after carrying out heating maintenance with a heat treating furnace at the austenitizing temperature of 850 degrees C, and making a base metamorphose into bainite, it cooled slowly.

*Beard*  
(3) After machining a drum section, the shank which becomes the ends from a hub and a shaft was used as the assembly and the top pinch roll.

*Schiff*  
(4) In this roll, a nest and when the online test was done for five months, the building-up roll currently used conventionally was burned on the bead section, and a good roll skin was maintained by the pinch roll section to dry rough skin occurring. About wear, with the example roll, it was 4.5mm in 4.5 months to the roll having been 5.2mm by the roll dry rough skin and wear by a bead crack conventionally in 4.5 months, and was good.

(EFFECT OF THE INVENTION)

As explained above [ the hot run table roller and the pinch roll for coilers of this invention ] The activity layer is formed with the graphite crystallization chromium cast iron construction material of the specific presentation containing nickel:3.5-4.5% and Cr:3.5-5.0%. Since the base was formed by tough bainite while making Cr carbide, and a cementite and a graphite generate It can become a thing possessing the extremely excellent abrasion resistance and printing-proof nature, and can apply enough also as the roller and pinch roll for semi wet zones with which the water screen by cooling water is not formed, and quality of a strip is not reduced. Moreover, as a result of a life's being excellent, there can also be little replacement frequency of a roller, can end and can reduce maintenance costs. Furthermore, since an expensive Ni content can be pressed down, it excels in profitability.

[Translation done.]

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